MORPHOLOGY OF PALIMPSESTS ON GANYMEDE FROM GALILEO OBSERVATIONS. K. B. Jones[1], J. W. Head[1], C. R. Chapman[2], R. Greeley[3], J. M. Moore[4], G. Neukum[5], R. T. Pappalardo[1], and the Galileo SSI Team. [1]Dept. of Geological Sciences, Brown University, Providence RI. [2]Southwest Research Institute, Boulder CO. [3]Dept. of Geology, Arizona State University, Tempe AZ. [4]NASA-Ames, Moffett Field CA. [5]DLR, Inst. Planetary, D-12489 Berlin.

INTRODUCTION

Palimpsests are large, low-relief, apparently impact-related circular structures on Ganymede and Callisto first imaged by Voyager. Analysis of Voyager images of these structures has resulted in many hypotheses and much debate but little consensus about their nature and mechanism of formation. Much of this debate centers around what the circular high albedo deposit, prominent in most palimpsests, represents. Hypotheses for the nature of this feature have included the edge of continuous ejecta [1], impact melt [2], the former crater rim [3, 4], the margin of impact-triggered extrusions [5], and the edge of the pedestal deposit [6]. The high-resolution images returned from Galileo of two palimpsests on Ganymede help shed some light on the origin of these poorly understood structures. In particular, based in part on observations of buried and exposed secondary and other craters and lineations, analysis of these images suggests that the high albedo deposit may correspond to the edge of the continuous ejecta deposit.

MEMPHIS FACULA MORPHOLOGY

Memphis Facula (16°N, 133°W) was imaged on orbit G1 at 55 m/pixel as a strip of 8 images stretching from near the palimpsest center to just beyond the edge of the high albedo deposit, or facula. Throughout the entire strip, Memphis Facula appears to be cut by closely spaced, subparallel lineations trending approximately NNW-SSE which are most pronounced outside the facula and decrease in prominence inward.

Outside the circular facula deposit, crater rims account for most short wavelength topography. These rims tend to have higher albedo than the surrounding dark surface. The regional lineations here are quite pronounced. Several smooth, dark areas radial to the center of Memphis Facula are present in this area, and in at least one case could consist of nearly continuous chains of similarly-sized craters. These chains are possibly secondaries produced during the formation of Memphis Facula. The contact between the high albedo deposit and the dark surface exhibits little topography, but may be a low outward-facing scarp.

Within the facula, Galileo images allow four distinct units to be distinguished, designated here I-a, I-b, II, and III from the outside of the palimpsest inward. An additional unit, IV, is visible in Voyager images but was not imaged well by Galileo. Unit IV appears in the very corner of the last frame of the Memphis Facula strip.

The outermost of these units, I-a, extends from the facula edge to about four-fifths of the facula radius and contains bright massifs or mesas in addition to small craters. The massifs or mesas may have been created during the palimpsest-forming event or may be dissected remnants of the rims of old craters buried in ejecta from Memphis Facula. The concentration of these features seems to increase steadily inward. This outermost unit is bordered on the inside by a distinctly scarp-bounded, sinuous, dark-floored trough.

Unit I-b appears to be topographically slightly lower than unit I-a. It extends from about four-fifths to two-thirds of the facula radius and consists of slightly smoother terrain than either of its adjacent units, I-a and II. Most of the topography in this area consists of massifs or mesas similar in appearance to those in unit I-a. The boundary between this unit and unit II is not distinct in Galileo images, although it is visible in Voyager images. An increase inward in short wavelength topography is the primary expression of this boundary in Galileo images.

Unit II is topographically the roughest unit. It extends from two-thirds to half of the facula radius. This unit contains a very high density of massifs, as well as several elliptical patches of dense concentrations of small craters. These small craters may be secondaries to large nearby impact craters. The boundary between this unit and the fourth unit in is fairly sharp and distinct.

Unit III, the innermost unit easily visible in Galileo images, is the smoothest high albedo unit imaged. It extends from half of the high albedo radius to about one-fifth of the radius, the end of the strip imaged by Galileo. There are many fewer massifs in this unit than in previous units, and they are smaller than those in other areas. The large pit crater present in this zone and its ejecta may obscure underlying palimpsest topography, however.

Seen clearly on Voyager images but not appreciably imaged by Galileo is an even smoother unit, unit IV, extending from the palimpsest center out to about one-fifth of the high albedo deposit radius.

Thomas and Squyres [5] previously suggested that crater floor albedos within bright palimpsest deposits could indicate whether or not craters had excavated through the bright palimpsest deposit into underlying darker material. In Galileo images of Memphis Facula, however, crater age appears to be correlated with crater floor albedo. Typically, the youngest, freshest craters have dark floors, while older, more degraded craters have higher albedo floors.

G2 PALIMPSEST MORPHOLOGY

The palimpsest at 24°N, 181°W, classified as a penepalimpsest by Passey and Shoemaker [1], was imaged on orbit G2 at 90 m/pixel as a strip of 9 images extending from the edge of the high albedo deposit to the palimpsest center and just beyond. Four distinct units were distinguished across the G2 palimpsest, designated I, II, III, and IV and corresponding approximately to the units designated above in the Memphis Facula description.

The amount of topographic roughness increases from the edge of the facula to three-quarters of its radius. This outermost high albedo unit, I, is markedly smoother than unit II. Near the outer edge of the bright palimpsest deposit, two strings of buried craters approximately radial to the palimp-

sest center are visible. Outside the facula is an exposed string of craters, also approximately radial. These craters are interpreted as secondaries produced during palimpsest formation. Those within the bright deposit boundary are partially buried in ejecta, while those outside the border are exposed.

Within unit II, from three-quarters to half of the facula radius, the palimpsest surface is rough and chaotic. This section exhibits the most obvious relief present in this palimpsest. Massifs, possibly remnants of buried craters, account for much of the topography seen in this unit.

In unit III, extending from half to about 15% of the bright deposit radius, the palimpsest surface is relatively smooth and free of massifs, except for a ring of massifs or short inward-facing scarp segments at about one-third of the bright deposit radius. This unit may be bordered on the outside by a low, discontinuous, inward-facing scarp.

A network of linear and curvilinear fractures is present on the palimpsest floor in unit IV, extending from the palimpsest center out to about 15% of the facula radius. Most of these cracks are approximately radial to the palimpsest center, but some fractures cross-cut others and some are anastomosing. These fractures may be the result of post-formation uplift of the palimpsest center.

IMPLICATIONS FOR PALIMPSEST FORMATION

The morphologies of both Ganymede palimpsests imaged at high resolution by Galileo are grossly similar. They both contain inner smooth zones, units III and IV, extending from the palimpsest center to just under half of the facula radius; a topographically rough unit, unit II, consisting of massifs and old buried craters extending to between two-thirds and three-quarters of the bright deposit radius; and then another smoother zone, unit I, extending to the edge of the high albedo deposit.

The presence of possible buried craters in the heavily textured unit II but lack of evidence for buried craters closer to the palimpsest centers in units III and IV suggests that unit II is located outside the original crater rims. Unit II, then, may be covered by a thick blanket of ejecta, possibly corresponding to the inner hummocky ejecta facies. Units III and IV, the interior smooth areas, were likely the areas excavated by the palimpsest-forming impact. Unit I in the G2 palimpsest increases in topographic roughness inward, suggesting that the ejecta covering this zone thickens inward. Possible secondaries in the G2 palimpsest images are observed to be buried by ejecta in the high albedo deposit but are exposed outside this deposit. Similarly, strong lineations visible outside the G2 palimpsest high albedo deposit are visible but subdued for a short distance within this deposit. These observations suggest that the edge of the faculae may correspond to the continuous ejecta limits. If this is indeed the case, however, the sharply defined facula edges make these continuous ejecta deposits unlike those observed on the Moon.

The scarp noted at four-fifths of the facula radius in Memphis Facula may be due to post-impact slumping inward of a section of palimpsest. This interpretation is suggested by the inward-facing scarp, the subconcentric trace of this scarp as seen in Voyager images, and the similarity of this feature to large-scale slumps seen in the Orientale Basin on the Moon [7].

REFERENCES: [1] Passey, Q., and E. M. Shoemaker, *Satellites of Jupiter*, 435, 1982. [2] Croft, S. K., *JGR* 88, B71, 1983. [3] Hartmann, W. K., *Icarus* 60, 56, 1984. [4] Lucchitta, B., et al., *LPS XIX*, 701, 1988. [5] Thomas, P., and S. Squyres, *JGR* 95, 19161, 1990. [6] Schenk, P., *LPS XXVII*, 1137, 1996. [7] Head, J., *Impact and explosion cratering*, 563, 1977.

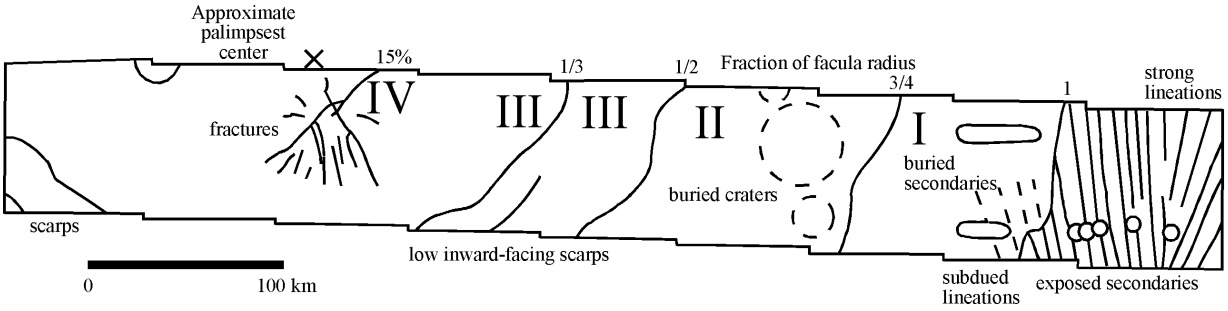

Figure 1. Sketch map of Memphis Facula as imaged by Galileo.

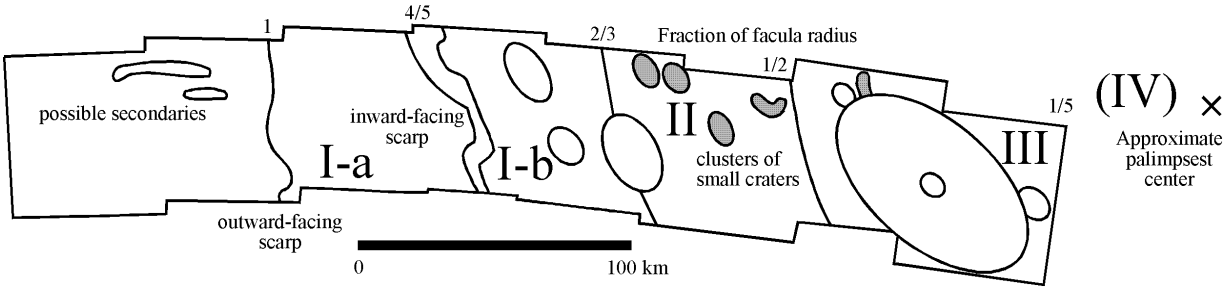

Figure 2. Sketch map of G2 palimpsest as imaged by Galileo.